6 Resources and Schedule

6.1 M&S and Labor Requirements

Budget history

The direct cost obligation budget history for the past 6 fiscal years, including extrapolation of 2008 expenditures is shown in Figure 6.1. These charges include activities on both the A0 Photoinjector and on SRF and infrastructure support at A0. However, they do not include costs for the SRF 3. 9GHz 3rd harmonic module (except for early R&D costs ~2005 and earlier). If one chooses the past 3 years as representative, about 87% of the M&S costs and 70% of the SWF costs go toward Photoinjector activity. The SWF numbers include matrixed support charges.

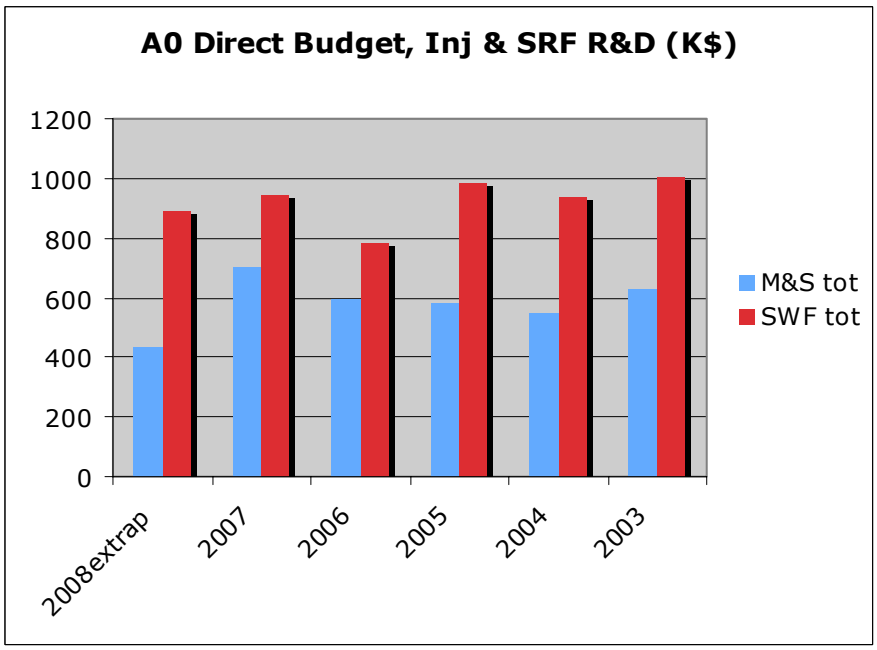

Figure 6.1: A0 Photoinjector budget history. Units are K$.

Not shown are funds from other sources such as NIU which provided for a laser oscillator replacement and for a helium recovery system. Technical Division support mainly for SRF R&D prior to ~2005 is not shown. Additionally in the last year or so, the support and effort from the Accelerator Division Instrumentation Group and the Computer Division has probably not been completely captured. Roughly speaking, the cost of operating the A0 Photoinjector has historically been ~1.5 M$/year.

A0 personnel

At present the Photoinjector Group consists of seven individuals: one post doc, 2 Engineering Physicists, a Guest Scientist, a programmer under contract from the University of Illinois, and 2 students. The two Engineering Physicists are the only "without term", i.e. permanent, staff. Additional effort comes from a senior scientist and senior engineering physicist at a small fraction of their time.

Matrixed support includes the group of mechanical technicians and temporaries located at A0 and effort from the "support groups" as needed. These include: Mechanical, Cryogenic, Instrumentation, Controls, Electrical, etc.

Future cost estimates

A detailed cost estimate has not been carried out and will require more design effort in order to have a better estimate. However, we can give a rough estimate of future costs.

We assume that the basic operating costs of the A0 Photoinjector, including minor upgrades such as LLRF improvements, BPM upgrade, etc., can be supported within the historical level of ~1.5M$. (M&S and SWF). We outline the additional costs from the major upgrades and expanded activities outlined in this proposal. We spread these additional costs evenly over 3 years. Not included in this estimate are costs for the new gun and cathode chamber, as these are costed elsewhere as part of the NML installation.

The remaining large cost items are (M&S + SWF, totaled over 3 years):

- the deflecting mode cavity – 1.1M$
- the cryogenic modifications for the deflecting mode cavity – 500K$
- major instrumentation additions (including 3 additional FTE's/year) – 1.4M$
- further laser systems such as one to interact with the electron beam, or improved drive laser – 250K$
- A0 group staff increase (3 additional FTE's/year) – 1.1M$

The cost of the deflecting mode cavity can be estimated from the 3.9 GHz 3rd harmonic cavity work. There has been considerable experience learned and costs should be considerably less than for the previous 3.9 GHz activity. Even so there is considerable uncertainty in the estimate. The cryogenic system will need to be increased for larger capability. This includes additional cryogenic distribution to the additional cavity, additional dewar usage per day, more vacuum pump capability, and controls and valves for the larger system. If the Tevatron turns off during the time before the move to NML, then a different helium recovery and refrigeration system must be implemented.

In summary we estimate the cost of the proposed future program at about ~3.0M$/year (M&S +SWF). This is approximately double the current expenditures.

Additional resources would be necessary if serious collaboration support were undertaken such as inverse Compton scattering with a strong outside group.

Looking toward future personnel needs

The present staffing level at the Photoinjector is under critical mass, and has insufficient scientific representation and full time leadership as well as an insufficient stable permanent core group. In order to carry out the activities outlined in this report, the staffing situation must be rectified. Certainly recent strong participation of the Instrumentation Group is a step in this direction, but an attempt to find a knowledgeable leader in advanced accelerator physics should be made.

6.2 Schedule

A general scenario for activities at the Photoinjector over the next few years would include:

- **8/08 - 4/09:** Continuation of the emittance exchange experiment and diagnostic development at 15 MeV. Look for micro bunching and CSR.
- **4/09 - 8/09:** Shutdown to replace the Gun and CC1 with new gun and higher gradient accelerating cavity (CC2). At this time extend both the straight ahead line and EEX line and add chicane in the straight ahead line. Install initial ICU experiment set up. Some cryogenic modification possible.
- **8/09 - 4/10:** Operate with new configuration. Characterize the new injector emittance, dependence on CC1 acceleration and compression. Investigate ICU and microbunching as well as further EEX and CSR.
- **4/10 – 10/10:** Shutdown to install deflecting mode cavity, modify cryogenics. At this shutdown install experiments related to laser beam interactions (laser heating, replica, Compton) depending on development of these ideas and available laser. Upgrade of the ICU experiment. .
- **10/10 – 2012?**: Operate with upgraded configuration and experiments till move of injector to NML. Additional shutdowns as necessary.